Semiconducting Nitrides: A New(?) Materials Science Frontier

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Recently, the Group IH-nitrides have attracted considerable interest in the semiconductor research community for their unique optoelectronic properties. These semiconductors have wide, direct band gaps and proposed applications for thcm run the gamut from blue LEDs and solar blind UV detectors to high temperature electronics. But is this really a ncw research area? The nitrides have been worked on since the 60's. In fact, pioneering work on nitrides has been done right here at USC under the direction of Prof. Gershenzon. The novelty driving the renewed interest therefore is that through the recent usc of improved growth techniques such as MOCVD and MBE, device quality material is finally being produced. However, considerable materials challenges remain, such as structural defect reduction in the epitaxial layers, finding shallow p-typc dopants and activating thcm, finding a suitable substrate for epitaxial growth and on and on.

JPL/NASA's interest in this technology is mainly in the area of detectors for UV astronomy. In this talk a broad overview of this exciting materials research area will be presented, followed by a description of specific aspects of the work at JPL. In collaboration with APA Optics Inc., the growth of AlGaN alloys using a "digital" approach (a superlattice consisting of alternating layers of AIN and GaN, with individual layer thicknesses determining the alloy composition) was examined at JPL. Digital alloys offer a unique solution to the problem of dopant activation and defect propagation in homogeneous alloys. In the course of this work it was found that the initial growth behavior of AlN and GaN layers on sapphire and SiC substrates by MOCVD under low pressure conditions is markedly different from that under atmospheric pressure conditions. Interfacial bonding conditions rather than lattice mismatch appear to have a stronger influence in determining the quality of epitaxy of the nitrides.